Antithrombogenic property of bone marrow mesenchymal stem cells in nanofibrous vascular grafts.

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Public Summary:

Scientific Abstract:
Nanostructured biomaterials have tremendous potential for tissue engineering. However, the performance and integration of the nanomaterials in vivo are not well understood. A challenge in vascular tissue engineering is to develop optimal scaffolds and establish expandable cell sources for the construction of tissue-engineered vascular grafts that are nonthrombogenic and have long-term patency. Here, we used tissue-engineered vascular grafts as a model to demonstrate the potential of combining nanofibrous scaffolds and bone marrow mesenchymal stem cells (MSCs) for vascular tissue engineering. Biodegradable nanofibrous scaffolds with aligned nanofibers were used to mimic native collagen fibrils to guide cell organization in vascular grafts. The results from artery bypass experiments showed that nanofibrous scaffolds allowed efficient infiltration of vascular cells and matrix remodeling. Acellular grafts (without MSCs) resulted in significant intimal thickening, whereas cellular grafts (with MSCs) had excellent long-term patency and exhibited well organized layers of endothelial cells (ECs) and smooth muscle cells (SMCs), as in native arteries. Short-term experiments showed that nanofibrous scaffolds alone induced platelet adhesion and thrombus formation, which was suppressed by MSC seeding. In addition, MSCs, as ECs, resisted platelet adhesion in vitro, which depended on cell-surface heparan sulfate proteoglycans. These data, together with the observation on the short-term engraftment of MSCs, suggest that the long-term patency of cellular grafts may be attributed to the antithrombogenic property of MSCs. These results demonstrate several favorable characteristics of nanofibrous scaffolds, the excellent patency of small-diameter nanofibrous vascular grafts, and the unique antithrombogenic property of MSCs.

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